GPS Monitoring at Vesuvio, Campi Flegrei Caldera and Ischia Island (Southern Italy)

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Somma - Vesuvio

Campi Flegrei - Solfatara

Mt. Epomeo - Ischia Island

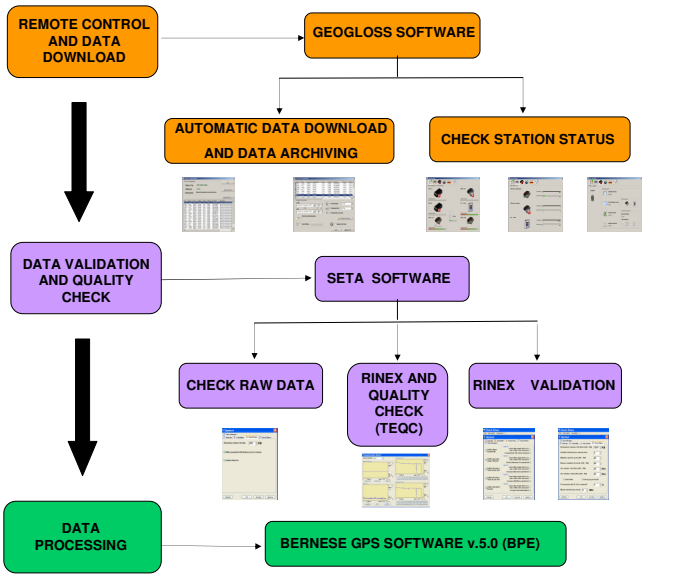
The Neapolitan Volcanic area

The Neapolitan volcanic area is located in the southern part of the Campanian plain and includes three active volcanoes (Vesuvio, Campi Flegrei Caldera and Ischia Island). This area shows different dynamical behaviours. Campi Flegrei caldera represents one well known and peculiar example of ground deformations (bradyseism), with periods of intense uplift during the 1969-72 and 1982-84, followed by subsidence phase with some episodic mini-uplifts superimposed. Contrary, Vesuvius is a substantially stable volcano, with small and localized subsidence mainly in the crater zone. Ischia Island has been characterized by subsidence in the S and NW sectors of the island. The presence of these three volcanoes in a dense populated area, makes ground deformation detection a crucial point in the risk mitigation.

Automated GPS Data Management and Processing

For real-time monitoring a system completely automated has been set (as shown in the scheme) All the GPS stations are managed by remote control trough cellular/phone modems or LAN/WiFi tecnologies and the raw-data are downloaded in automatic and programmed mode using a home-made software, named GEOGLOSS. The reformatting of the data into RINEX format and quality check of the data is also performed by a using another home-made program, named SETA, based on teqc software. After rinex validation the data processing is performed by the *Bernese Processing Engine* (BPE) of the Bernese GPS software v. 5.0.

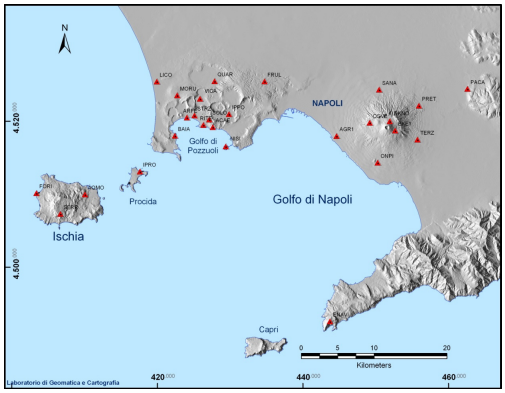
Considering the low dynamic of the volcanic area, this system is set to start on daily basis and it is designed also to follow a fast deformation dynamic ensuring data downloading and processing with sampling rate up to 1s



The NeVoCGPS network

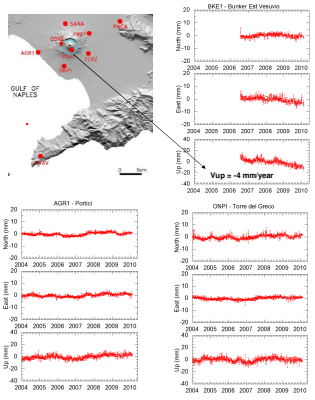
Ground deformation is an important volcanic precursor, because linked to magma overpressure and migration or to shallow aquifer system changes. Thus, continuous monitoring and modelling is one of the main instruments to attempt for a short time forecast of eruptive activity

Since several years, the INGV – Osservatorio Vesuviano installed a permanent GPS network (NeVoCGPS), constituted of 27 stations, in the Neapolitan volcanic area with a configuration that guarantees a constant and fast 3D information about the dynamics of the area.



VESUVIO

In the Vesuvio area the GPS stations show no significant ground deformation evidence. Only in the crater zone subsidence phenomena have been observed, which probably linked to phenomena of pyroclastic deposits compaction and landslides on the steep slopes

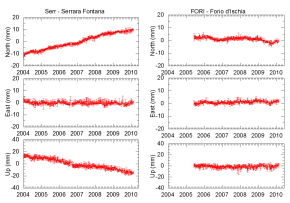


GPS time series of weekly coordinate changes, from 2004 to present, (along North, East and Up directions) for some stations in the Vesuvio area

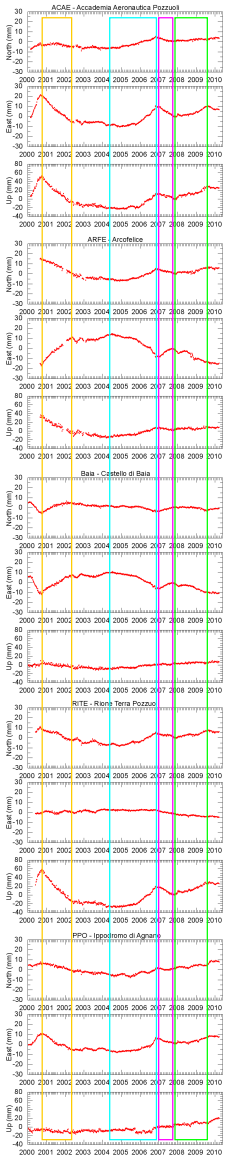
ISCHIA

Ischia Island has been characterized by subsidence in the NW and S sectors of the island where active sliding occurs.

The GPS station SERR, located in the southern sector shown a subsidence of about 5 mm/year



GPS time series of weekly coordinate changes, from 2004 to present, (along North, East and Up directions) for some stations in the Ischia area



CAMPI FLEGREI

GPS data analysis, during last decade,allowed continuous and accurate tracking of ground deformation affecting Campi Flegrei area, providing a 3D displacement field, allowing to better constrain the inflation/deflation sources responsible for ground movements.

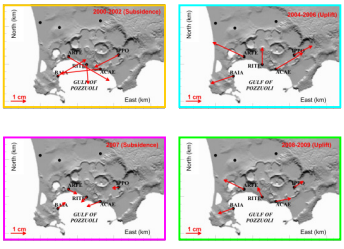
It should be noted that during these episodes the behaviour of planimetric components has been consistent with a source of inflation/deflation localized in an area around Pozzuoli.

GPS time series of weekly coordinates changes from 2000 to present along North, East and Up directions showing significant displacements. In this time interval three episodes of mini uplifts occurred.

The first one occurred from March to October 2000 and was partial recorded by GPS stations that were installed during May. This event was followed by a subsidence until October 2002 with a maximum value over than 7 cm.

After a period of substantial stability a second uplift episode occurred from November 2004 to November 2007 with a maximum uplift of over 4 cm, followed by a subsidence period up to October 2007 with a maximum value of nearly -2 cm.

In late 2007, finally, the ground has once again reversed the movement direction with an uplift that, in October 2009, has reached about 3 cm. After that, a new phase of substantial stability seems to be started, even if in presence of an oscillating trend.



Map of campi Flegrei with CGPS points and inferred planimetric displacements in the different period.

GPS time series of weekly coordinate changes, from 2000 to present, (along North, East and Up directions) for some stations in the Campi Flegrei area